

**WHAT IS CLAIMED IS:**

1           1. A polarization transformer operable to reorient polarization components of  
2 an incident optical signal, the polarization transformer comprising:  
3           a continuously adjustable retarder operable to provide reset-free operation and  
4           continuous control of a polarization state of the optical signal; and  
5           a limited-range adjustable retarder located in optical communication with the  
6           continuously adjustable retarder and operable to provide limited-range  
7           control of the polarization state of the optical signal.

1           2. The polarization transformer of claim 1 wherein the continuously  
2 adjustable retarder includes a wave plate.

1           3. The polarization transformer of claim 2 wherein the wave plate is a half-  
2 wave plate.

1           4. The polarization transformer of claim 2 wherein the continuously  
2 adjustable retarder includes:  
3           a motorized rotatable mount coupled to the wave plate, wherein the motorized  
4           rotatable mount is operable to continuously rotate the wave plate about  
5           an axis normal to a surface of the wave plate.

1           5. The polarization transformer of claim 1 wherein the continuously  
2 adjustable retarder is located with respect to the limited-range adjustable retarder so as  
3 to receive the optical signal from an optical source and to transfer a transformed  
4 optical signal the to the limited-range adjustable retarder.

1           6. The polarization transformer of claim 1 wherein the limited-range  
2 adjustable retarder includes a liquid crystal retarder having at least one liquid crystal  
3 cell.

1           7. The polarization transformer of claim 6 wherein the at least one liquid  
2 crystal cell includes:  
3           a first substantially transparent window;  
4           a second substantially transparent window; and

5 a liquid crystal medium located between the first substantially transparent  
6 window and the second substantially transparent window.

1 8. The polarization transformer of claim 6 wherein the liquid crystal retarder  
2 includes a plurality of electrodes for applying a voltage to the at least one liquid  
3 crystal cell.

1 9. The polarization transformer of claim 6 wherein the liquid crystal cell  
2 includes a liquid crystal material.

1 10. The polarization transformer of claim 9 wherein the liquid crystal material  
2 is a nematic liquid crystal material.

1 11. The polarization transformer of claim 9 wherein the liquid crystal material  
2 is a ferroelectric liquid crystal material.

1 12. The polarization transformer of claim 11 wherein the liquid crystal  
2 material is a fluorinated ferroelectric liquid crystal material.

1 13. The polarization transformer of claim 6 wherein the at least one liquid  
2 crystal cell includes a first liquid crystal cell, a second liquid crystal cell, and a third  
3 liquid crystal cell.

1 14. The polarization transformer of claim 13 wherein the first liquid crystal  
2 cell and the third liquid crystal cell transform the polarization state of the optical  
3 signal in a first direction, and wherein the second liquid crystal cell transforms the  
4 polarization state of the optical signal in a second direction.

1 15. The polarization transformer of claim 6 wherein the limited-range  
2 adjustable retarder includes:  
3 a second liquid crystal retarder having at least one liquid crystal cell and being  
4 located in optical communication with the liquid crystal retarder; and  
5 a quarter-wave plate located between and in optical communication with the  
6 liquid crystal retarder and the second liquid crystal retarder.

1 16. The polarization transformer of claim 1 wherein the limited-range  
2 adjustable retarder includes at least one of a lithium niobate crystal, a lanthanum

3 modified lead zirconate titanate (PLZT) material, and a mechanically stressed optical  
4 fiber.

1 17. The polarization transformer of claim 1 wherein the limited-range  
2 adjustable retarder is located with respect to the continuously adjustable retarder so as  
3 to receive the optical signal from an optical source and to transfer a transformed  
4 optical signal to the continuously adjustable retarder.

1 18. The polarization transformer of claim 1 wherein the limited-range  
2 adjustable retarder has a first response time and the continuously adjustable retarder  
3 has a second response time, the first response time being shorter than the second  
4 response time.

1 19. The polarization transformer of claim 1 further comprising:  
2 a controller operable to provide control signals to the limited-range adjustable  
3 retarder and to the continuously adjustable retarder.

1 20. A system for compensating for polarization mode dispersion in an optical  
2 signal, the system comprising:

3 a polarization transformer operable to reorient polarization components of an  
4 incident optical signal, the polarization transformer including:  
5 a continuously adjustable retarder operable to provide reset-free  
6 operation and continuous control of a polarization state of the  
7 optical signal; and

8 a limited-range adjustable retarder located in optical communication  
9 with the continuously adjustable retarder and operable to  
10 provide limited-range control of the polarization state of the  
11 optical signal;

12 a delay system operable to adjust the relative delay between a first reoriented  
13 polarization component of the optical signal and a second reoriented  
14 polarization component of the optical signal; and

15 a controller coupled to the polarization transformer and operable to provide  
16 control signals to the limited-range adjustable retarder and the  
17 continuously adjustable retarder.

1 21. The system of claim 20 wherein the continuously adjustable retarder  
2 includes a wave plate.

1 22. The system of claim 21 wherein the wave plate is a half-wave plate.

1 23. The system of claim 21 wherein the continuously adjustable retarder  
2 includes:

3 a motorized rotatable mount coupled to the wave plate, wherein the motorized  
4 rotatable mount is operable to continuously rotate the wave plate about  
5 an axis normal to a surface of the wave plate.

1 24. The system of claim 20 wherein the limited-range adjustable retarder  
2 includes a liquid crystal retarder having at least one liquid crystal cell.

1 25. The system of claim 24 wherein the liquid crystal retarder includes a  
2 plurality of electrodes for applying a voltage to the at least one liquid crystal cell.

1 26. The system of claim 24 wherein the liquid crystal cell includes at least one  
2 of a nematic liquid crystal material, a ferroelectric liquid crystal material, and a  
3 fluorinated liquid crystal material.

1 27. The system of claim 24 wherein the limited-range adjustable retarder  
2 includes:

3 a second liquid crystal retarder having at least one liquid crystal cell and being  
4 located in optical communication with the liquid crystal retarder; and  
5 a quarter-wave plate located between and in optical communication with the  
6 liquid crystal retarder and the second liquid crystal retarder.

1 28. The system of claim 20 wherein the limited-range adjustable retarder  
2 includes at least one of a lithium niobate crystal, a lanthanum modified lead zirconate  
3 titanate (PLZT) material, and a mechanically stressed optical fiber.

1 29. The system of claim 20 wherein the limited-range adjustable retarder has  
2 a first response time and the continuously adjustable retarder has a second response  
3 time, the first response time being shorter than the second response time.

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1           30. The system of claim 20 wherein the delay system is located with respect  
2 to the polarization transformer so as to receive the first reoriented polarization  
3 component of the optical signal and the second reoriented polarization component of  
4 the optical signal from the polarization transformer.

1           31. The system of claim 20 wherein the delay system includes a polarization  
2 maintaining optical fiber.

1           32. The system of claim 20 wherein the delay system includes at least one of  
2 mechanically stressed optical fiber and a heated optical fiber.

1           33. The system of claim 20 further comprising:  
2 a detector coupled to the controller; and  
3 an optical tap operable to provide at least a portion of the optical signal to the  
4 detector.

1           34. The system of claim 33 wherein the optical tap includes a beamsplitter.

1           35. The system of claim 33 wherein the detector includes:  
2 a photodetector; and  
3 an error signal circuit.

1           36. The system of claim 20 wherein the controller includes:  
2 at least one amplifier for amplifying and detecting an error signal related to the  
3 intensity of the optical signal; and  
4 at least one voltage source coupled to receive the error signal and to provide a  
5 voltage based on the error signal to the polarization transformer.

1           37. The system of claim 36 wherein the at least one amplifier is a lock-in  
2 amplifier.